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JOSEPH A. WILLIAMS, OF CLEVELAND, OHIO.

PROCESS OF MAKING IRON, STEEL, OR STEEL ALLOYS.

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To all whom it may concern:

Be it known that I, JOSEPH A. WILLIAMS, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Process of Making Iron, Steel, or Steel Alloys, of which the following is a full, clear, and exact description.

This invention relates to a process of making iron, steel, or steel alloys without subjecting any of the materials employed to a melting or smelting process.

The principal object of the invention is to provide a process which results in a very high grade product such, for example, as is desired for the production of certain accurately formed parts heretofore made by casting and subsequent machining, and such as is desired for the production of tools, dies, cutlery, etc.

More particularly the invention aims to provide a process by which a product is obtained which is entirely or substantially entirely free of impurities, and in so far as the production of steel or steel alloys is concerned, to produce a product having a known or absolutely definite carbon content, or a definite content of the alloying metal or metals; also a product which is homogeneous chemically and physically, and one free of so-called segregations, blowholes and the like.

The invention may be briefly summarized as consisting in certain novel steps of the improved method which will be described in the specification and set forth in the appended claims.

Though the invention is not confined to any particular form or construction of apparatus, in the drawing I have shown conventionally in vertical section, an apparatus which may be used to advantage in carrying out the principal steps of the process.

In carrying out my improved process I prefer to start with iron or steel scrap, such as borings, punchings, cuttings, clippings and the like, with the parts preferably in fairly small form, and cleaned, if necessary, to remove foreign substances. In the event the scrap is of fairly large size, it can be chopped into pieces of suitable small size.

I prefer to start with scrap iron or steel, as just stated, for the reason that I find that I can in this manner obtain material which for all practical purposes is free of impurities. At any rate, this material is exceedingly more free of impurities than the best available grade of ore such as iron oxide.

As the first chief step of my improved process, assuming that clean scrap material of the right size is obtained, I convert the material to an oxide of iron in a powderous form. This is preferably done in apparatus such as shown in the drawings, namely, in a heated tumbling container through which a suitable oxidizing medium is passed. This same apparatus can be used to advantage also in carrying out the subsequent steps of the process. I will therefore briefly refer to the drawing, in which Figs. 1 and 2 are longitudinal and transverse vertical sections, respectively, showing apparatus which may be used in carrying out the process.

The apparatus shown in the drawing includes an outer heating chamber 10 carrying an inner revoluble container 11, rotatably supported through the medium of hollow shafts or trunnions 12 in opposite walls of the chamber 10. The inner chamber 11 may be rotated by any suitable means, such as indicated at 13. The outer chamber is preferably provided with suitable orifices or pipes 14 for the supply of heating gases or flames which can be directed as desired, or the chamber 10 can be otherwise heated. The chamber 11 is preferably formed of a suitable non-oxidizing material such as nickel.

It is in the inner chamber 11 that the steps of the process are carried out, i. e. the oxidizing step, the subsequent reducing step, and the carbonizing step if steel is produced, the gases for accomplishing these results being preferably admitted and withdrawn from the chamber 11 through the trunnions. In this instance gas supply pipes 15 are shown for supplying the gases for these purposes.

The material which is first to be oxidized, is supplied to the chamber 11, which will be provided with a suitable man-hole for this purpose, and when the chamber is heated to the right temperature, which may be varied, but preferably about 1400° to 1600° Fahrenheit, the oxidizing gas or medium is passed through the chamber while it is undergoing a continuous rotation. For the oxidizing medium I prefer to use steam, though any other suitable gas may be em-